Art. III.—*The Stony Creek Basin and the Corinella Dyke.*

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Contents.

I.—Introduction.

The subject of this paper is a curious, amphitheatrical depression about 50 acres in area lying immediately south of Jubilee Park, $1\frac{1}{4}$ miles south of the Daylesford Post Office. The Stony Creek enters it in the south-west corner by a narrow gorge, flows along the western side, and leaves by a similar gorge in the north-west corner. Exposed by sluicing channels in the basin are ligneous shales with numerous fossil Eucalypt leaves, remains of diatoms, and abundant fresh water sponge spicules. The deposits have been penetrated in a shaft for over 100 feet.

The map showing the relation of the Stony Creek basin to the Corinella dyke is compiled from Quarter-Sheet No. 16 SE. of the Geological Survey. A correction due to Mr. Whitelaw (1) is made to the boundaries of the basalt and Ordovician in the neighbourhood of the basin.

Much of the information about the shafts and deep leads in the Eganstown district was obtained from Mr. Rehir, of the Victoria Hotel, Daylesford, who was digging there in the '90's.

II.—Previous Literature.

In his notes on Quarter-Sheet No. 16 SE.. Mr. Hunter (2) refers to the basin as "a deep hole without an outlet," and considers it a point of Pliocene volcanic eruption. In a recent conversation Mr. Hunter informed me that he is now inclined to regard the basin as a faulted block.

T. S. Hart (3) has discussed the origin of the basin in some detail. His view of the sequence of events is summarised as follows:—The black clays were deposited prior to volcanic activity, or as a result of the first modifications of the drainage systems by the volcanic action. A portion of these was preserved by subsidence on a well defined line of weakness, namely, a line through the Corinella dyke, the zone of fracture in Sailor's Creek, and Wheeler's Hill. The streams flowing on the

west and north sides of the basin may have flooded it. The lava flows from Leonard's Hill then buried the old river valleys and at least part of the basin. The drainage towards the pre-basaltic stream resulted in the formation of Sailor's Creek on the western, and Stony Creek on the eastern, side. The basaltic barrier across the exit from the basin formed a bar, which was only cut through slowly. While the bar was being cut through, the stream cut out a plain in the easily eroded black shales. A considerable amount of basalt could have been removed at the same time by undercutting.

While these latter conclusions are most probably correct, the earlier sequence leading to the deposition of the ligneous shales seems to be capable of a more satisfactory explanation.

Mr. Whitelaw (1) states that "the area is a foundered block at the intersection of the Ajax group of thrust faults, and a younger cross fault."

III.—Nature of Basin.

The floor of this crateriform depression lies about 100 feet lower than the rim. It is surrounded on the west and the northern sides by a basaltic plateau, in which is entrenched the Stony Creek Gorge. Deep leads occur under the basalt, but about 50 feet higher than the level of the basin. The southern and eastern banks are formed of Ordovician slates and shales, which rise to somewhat higher levels than the basaltic plateau. In the north-east corner, Pliocene alluvial gravels outcrop at the surface. The floor of the basin, which consists of recent alluvium, is fairly level, rising to the north and the east. It is dissected by numerous sluicing channels. In the most easterly of these, black ligneous shales are exposed at several places. When dry, they change to a drab colour. They are very fine grained, and contain numerous wood fragments and fossil Eucalypt leaves. Diatoms and fresh water sponge spicules have been also recorded (1) from them. These deposits have evidently accumulated in the still waters of a lake, or some allied formation. Mr. Hart claims that the shales dip from 45° to vertical, and that they therefore have been much disturbed since their deposition. In the sections examined in the basin the bedding was generally obscure, but no evidence of a steep dip was obtainable. In 1864 a shaft was sunk near the southern wall through these ligneous shales for over 100 feet. Alluvial wash was struck at 111 feet. It is doubtful whether the shaft ever reached bedrock.

Thin seams of similar black ligneous clays occur under the basalt at Sailor's and Stony Creek Falls. These contain a fair proportion of coarse grit, and no traces of either diatoms or sponge spicules, as would be expected from the nature of their occurrence.

Similar deposits have been recorded (4) from the Exchequer Co.'s shaft on the Royal Oak lead from Wombat Hill, where a

thickness of 85 feet was passed through. The deposit contained wood in all stages of transformation into lignite, intermixed with leaves in all stages of preservation, identical with those of the present day. The wood was frequently replaced by pyrite. At Eganstown the shafts of the Great Extended, whose claim adjoins the eastern boundary of the Corinella pre-emptive right, and the shaft of the New National, whose claim joins the eastern boundary of the Great Extended claim, both passed through 100 feet of tripoli (diatomaceous earth).

Conditions at the time of the Newer Volcanic activity were evidently favourable to the development of diatomaceous life, as the deposits formed by the accumulation of their remains are associated with the Newer Basalt in many Victorian localities (5).

As previously stated, Mr. Hart considers that the black ligneous shales and clays of the Stony Creek basin are remnants of a much more extensive deposit preserved by faulting. He suggests their correlation with the deposits met with in the Exchequer shaft, and in the Great Extended and New National shafts at Eganstown. This would imply the existence, immediately prior to the Newer Basaltic eruptions, of lake conditions necessary for the accumulation of a deposit 100 feet in thickness over the greater part of the Daylesford area. If such conditions had existed, one would expect to find many other remnants of the deposit. These are absent, and it is more probable that these three areas of ligneous clays are of quite local and restricted occurrence, and that the Stony Creek Basin deposits have accumulated there, filling in an originally much deeper basin.

The most probable direction of the deep leads is shown in the map. At the places where the lead is shown to enter and leave the basin, the basalt extends down to a lower level than elsewhere. On the western side it is difficult to determine how much the relations have been interfered with by landslips. The steep slopes are covered with a dense growth of blackberries, which adds to the difficulty of locating the rock boundaries. Landslips have also obscured relations where the lead is shown to cross on the east bank of the Stony Creek gorge. It is however fairly certain that the basalt reached a much lower level here. River gravels which outcrop beneath the basalt in this neighbourhood also indicate that the lead crosses in that region. The exit of the lead exposed in the cutting of the Ballarat Road can be readily and definitely located.

Prior to entering the basin, the bed of the Stony Creek, down-stream from the falls, consists of Ordovician slates and sandstones. Immediately it enters the basin all signs of Ordovician in the bed of the creek disappear. The stream then flows over basaltic boulders until the north-west corner is reached, where Ordovician reappears and, from there down-stream, continues to form the bedrock of the creek. Besides forming the high east and south banks, the Ordovician slates and sandstones outcrop

beneath the basalt on the north and west sides. The shaft near the south bank, previously mentioned as passing through more than 100 feet of black ligneous clays, shows that the junction between clays and Ordovician must continue very steeply below the surface here.

IV.—Origin of the Basin.

To account for such a formation in which a floor of Ordovician slates and sandstones is enclosed by walls of Ordovician and Ordovician capped by basalt, which rise to a height of 200 feet above the Ordovician floor, two modes of origin may be suggested. These are (*a*) volcanic explosive activity, and (*b*) subsidence by faulting.

The first method was suggested by Mr. Hunter (1). The evidence rather indicates that such was not the case, for although the basin is surrounded on the north and west sides by basalt, this had its source at Leonard's Hill, some six miles to the south. Nor is there any sign of volcanic fragmental rocks or accumulations of broken Ordovician material around the basin, as would be the case if it were due to a volcanic explosion.

This leaves the second method of origin, namely, faulting. As will be seen in the next section, the basin lies at the extremity of a well defined line of weakness and fissuring, at the time of the Newer Basaltic eruptions. It is, nevertheless, rather difficult to picture the cause and manner by which a cylindrical block could be depressed vertically 200 feet, by faulting.

Consequent on the formation of the basin by faulting, the sequence of events was probably as follows:—It was flooded by the pre-basaltic stream whose valley was later filled by the basalt flow from Leonard's Hill. The course taken by this stream is indicated in the map showing the direction of the present deep leads in the neighbourhood of the basin. In the lake thus formed, especially in the still backwaters, conditions would be favourable to the accumulation of the black ligneous shales. That the material brought into the basin by the stream was of a suitable nature to form such a deposit is proved by the presence of similar black ligneous clays beneath the basalt at Stony Creek falls, and further south at Sailor's Creek falls. It is probable that the basin was entirely filled by these ligneous clays, as there is no indication that much of the area occupied by the present basin was covered by basalt, and certainly not by any great thickness of basalt. Next came the pouring out of lava from Leonard's Hill, filling the old creek valley, its channel through the basin, and covering possibly part of the present basin. The concentration of the drainage down the old river slopes towards the basalt flow gave rise to the present Stony Creek on the east side and Sailor's Creek on the west side of this flow. While cutting through the basalt bar at the north-west end of the basin, the Stony Creek cut a plain in the easily eroded black shales, undermining any basalt that might

have overlain these. Since the extrusion of the Newer Basalt, the streams in the Daylesford area have been rejuvenated, and the present stream level is now generally some 50 feet below the level of the old deep leads. Once the bar was cut through, the basin was drained, and deepened as the Stony Creek deepened its bed, so that the floor is now well below the level of the old deep leads. Recent alluvium derived from the slopes has covered the igneous clays, which are at present only exposed in the sluicing channels.

V.—The Corinella Dyke and its relation to the Stony Creek Basin.

The boundaries of the feature marked in the map as the Corinella Dyke are largely hypothetical. They have been taken from Quarter-Sheet No. 16 SE. of the Geological Survey. In the Corinella pre-emptive right paddock, where it is shown with a width of 14 chains, it is questionable how much of the basalt between these boundaries can be regarded as actual dyke and how much as surface rock. The basaltic hill shown on the dyke in the Corinella paddock is characterised by the vesicular nature of the basalt there as a point of eruption. Burnt Hill immediately to the SW. is very curious in structure. It is marked on the survey map as Ordovician, and a note is appended to the effect that it is a "made hill of deposit." It seems to consist on the upper slopes of a mixture of Ordovician and basaltic boulders, mostly scoriaceous in nature. One, when broken, was found to be holocrystalline, probably a type allied to essexite. It was too incoherent to permit a thin section being made for microscopical examination. This hill is probably the result of explosive volcanic activity.

A microscopical examination of sections cut from samples taken at various places along the dykes, shows the material to be a rather fine grained olivine basalt. Much of it is, on a small scale, of a spheroidal character, which gives outcrops of the unweathered rock a characteristic appearance.

Much of the surface rock in the Corinella paddock is extrusive basalt that has filled in pre-basaltic river valleys. The deep leads have been worked and found to be very rich. At a point on the S. margin of the Corinella dyke (opposite the letter "D" in "Dyke" on the map) a lead, which was being worked in 1895, ran against a a wall of basalt and was lost. It had proved to be very rich at this locality, and its disappearance gave rise to considerable discussion. On the advice of Mr. Hunter, who was surveying the area at the time, it was sought on the north side of the dyke, where it was subsequently picked up. To try and locate the lead a shaft was sunk between these two points to a depth of 120 feet. It was abandoned still in basalt.

Further east two other shafts have been sunk in the dyke. The Great Extended shaft (4) bottomed at 240 feet with a "dip of 16°

MAP OF CORINELLA DYKE & STONY CREEK BASIN.

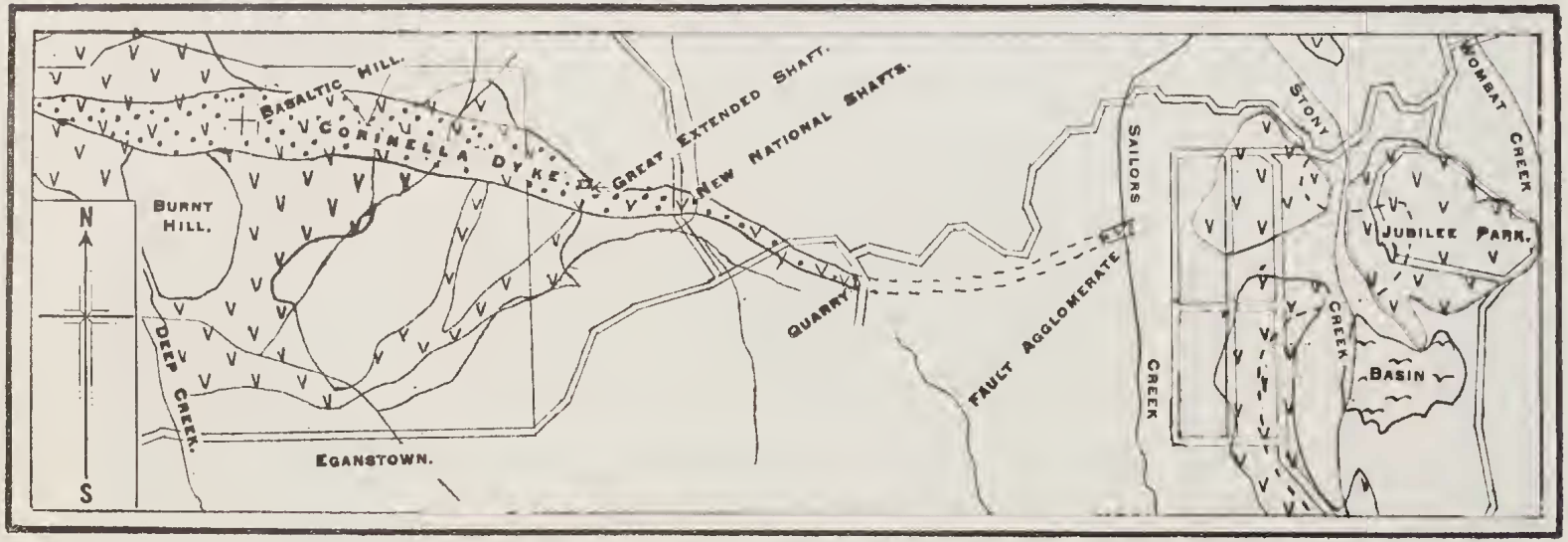

FIG. 1.

feet" in the shaft. It is supposed to have passed through infusorial (diatomaceous) earth. The shaft is on the northern margin of the dyke, and only passed through several feet of basalt. Levels opened towards the south met a wall of basalt. No sign of diatomaceous earth was found in the dump heap around the shaft. This was found to consist largely of a volcanic agglomerate composed of fragments of Ordovician slate and sandstone, and fragments of volcanic rock set in a fine greyish matrix that is possibly largely volcanic. Professor Skeats (6) has recorded a somewhat similar occurrence of a monchiquite agglomerate from Kangaroo Gully near Bendigo. He concludes that it had originated through explosive volcanic activity. It is possible that it was this material that was mistaken for the diatomaceous earth through which the shaft was supposed to have passed. It is suggested that this agglomerate fills a fractured zone in the Ordovician bedrock, and owing to a southerly dip in this zone the shaft passed into normal Ordovician at a depth of 246 feet.

Further east the dyke narrows to a width of 2 to 3 chains. In 1865 the New National Co. sank two shafts here. The first, which reached a depth of 250 feet, is recorded (4) as passing through 50 feet of clay, 100 feet of infusorial remains, and 100 feet of basaltic boulders and drift. It was abandoned at 250 feet in drift. The other shaft bottomed at 273 feet in the north-east corner with a "dip of 10 feet" to the south-east in the shaft. Ordovician bedrock is proved by shafts to extend up to the dyke on both sides at this part. As the dyke is only 2 to 3 chains in width the accumulation of over 200 feet of drift and diatomaceous earth beneath it is a remarkable occurrence, especially since the lower 100 feet consists of "basaltic boulders and drift." As the deposit is sub-basaltic and older than the basaltic dyke, no source for these basaltic boulders suggests itself. It is most probable that here again, as in the Extended shaft, the "tripoli" is really a volcanic agglomerate, a large proportion being a very fine volcanic paste decomposed to a greyish clay. Lower down, the pieces of undecomposed volcanic material may be more numerous and larger in size, and the agglomerate was then mistaken for "basaltic boulders and drift."

From these shafts, the course of the dyke eastwards is marked by a red basaltic soil. The most easterly outcrop is in a quarry. Here the dyke has split into two walls separated by Ordovician. It evidently ends at this point, for it does not outcrop further east. But between the quarry and the Stony Creek basin, a wide fractured zone in the Ordovician rocks is exposed in the bed of Sailor's Creek. The rocks here have been shattered and twisted. Forming a matrix of this broken material is a greyish white paste which has no perceptible gritty feel. It is probably decomposed volcanic matter. According to Mr. Whitelaw (1) this fault displaces the country to the north side 5 chains to the right. There is no trace of this fractured zone between Sailor's Creek and the

Basin, though it undoubtedly extends further eastward. The nature of the country here makes it very unlikely that any surface outcrops could be detected.

To account for this Corinella Dyke two hypotheses are available. The first is not very satisfactory, but would account for the presence of diatomaceous earth in the Great Extended and the New National shafts. According to this hypothesis, the first event to take place was the fracturing and fissuring of the Ordovician rocks, developing a depressed trough-faulted block in the Corinella paddock, and narrowing into a deep fissure towards the Great Extended and New National Co.'s shafts. Further east it is represented by the fractured zone in the bed of Sailor's Creek and terminates in the foundering of the Stony Creek basin block. The later development of this basin has already been traced. The Corinella downfaulted area was probably flooded by the streams in the area and partly filled by drift. The presence of the basaltic boulders in this drift cannot be explained, and remains an important argument against this mode of origin. The amount of alluvial material washed into this lake decreased, and in the clearer waters, diatoms flourished and the accumulation of their remains, mixed with finer sediment, formed a deposit about 100 feet in thickness. In Newer Volcanic times activity was renewed along this zone of fracturing, and basalt was intruded in places as a dyke, and extruded from a localised centre of eruption, filling in the trough fault and fissure, and covering over the diatomaceous deposits. In the quarry the basalt is probably intruded as a dyke. The volcanic hill in the Corinella paddock is the centre of the effusive type of eruption. In the neighbourhood of the Great Extended shaft, volcanic material was explosively injected into the Ordovician along the old fault zone, forming the volcanic agglomerate.

The second hypothesis pictures a much more probable series of events. It assumes that the term "tripoli" has been mistakenly applied to a fine volcanic agglomerate while a coarser agglomerate has been mistaken for a drift containing basaltic boulders. Along the Corinella fault line a shattered zone was developed in the Ordovician, and into it was explosively injected volcanic material, forming a dyke of volcanic agglomerate. In places, as at the upper parts of the Extended and New National shafts, a fine volcanic matrix forms the predominant part of the agglomerate, while at the Sailor's Creek zone it is mainly composed of shattered blocks of Ordovician. In the eastern extremity the sagging of the beds formed the Stony Creek basin. Contemporaneously with the formation of this volcanic agglomerate, or at a slightly later date, came the injection of basalt along this line of weakness. The intrusion in the eastern part was confined to a dyke, but in the west became effusive, culminating in the central type of eruption denoted by the volcanic hill in the Corinella paddock.

VI.—Summary.

A peculiar depressed basin of about 50 acres in area occurs immediately south of Jubilee Park, Daylesford. It is surrounded on all sides by Ordovician slates and shales, which rise to a height of 100 feet above the floor of the basin. The north and west sides are capped by basalt, under which are deep leads about 50 feet higher than the floor. It is open to the Stony Creek, which flows along the west side. Exposed in sluicing channels, are ligneous shales and clays containing diatoms and fresh water sponge spicules. These have been penetrated by a shaft for over 100 feet.

This basin is considered to have originated by the depression of a block of Ordovician, and to have been flooded by a pre-basaltic stream. It was filled by ligneous clays. The stream entering the basin was carrying similar material. In the quiet backwaters, conditions would be favourable for the growth of diatoms and fresh water sponges. The pre-basaltic stream, and perhaps part of the basin, was then filled by basalt. The twin streams, Sailor's Creek and Stony Creek, developed. While cutting through the basalt bar at the north side of the basin, Stony Creek cut out a wide plain in the easily eroded black shales, undermining any basalt that covered them. The basin was subsequently deepened as the stream entrenched itself deeper into bedrock.

The basin lies at the east extremity of a line of fracture and intrusion in late Kainozoic times. At Eganstown this is known as the Corinella dyke. Shafts through this dyke are supposed to have passed through diatomaceous earth. No trace of this is found around the dump heaps, but one consists largely of a volcanic agglomerate with a large proportion of fine greyish matrix. This was possibly mistaken for diatomaceous earth. Two alternative explanations are considered to account for the known facts. The more probable is that a fractured and shattered zone was developed in the Ordovician rocks. Accompanying this was the explosive injection of volcanic material forming a volcanic agglomerate. The proportion of volcanic material to shattered Ordovician varies at different parts. Contemporaneously, or at a slightly later date, came the intrusion of basalt along the same line of fracture as a dyke, culminating in the west in extrusive volcanic action.

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